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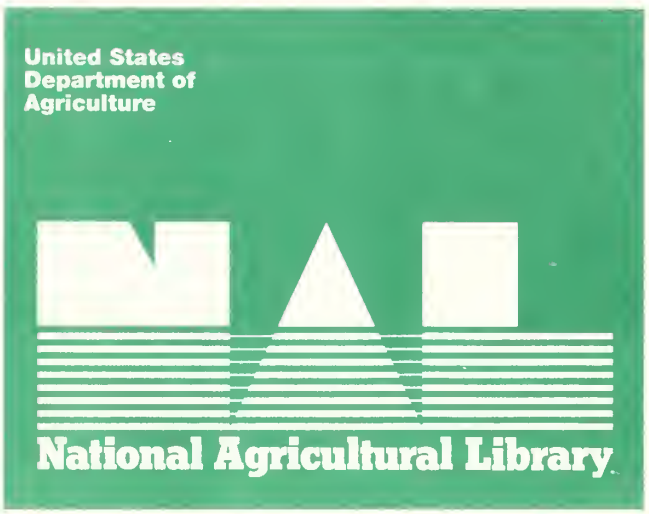
The WIC Breastfeeding Report:

The Relationship of WIC Program Participation to the Initiation and Duration of Breastfeeding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THE WIC BREASTFEEDING REPORT: THE RELATIONSHIP OF WIC PROGRAM PARTICIPATION TO THE INITIATION AND DURATION OF BREASTFEEDING

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September 15, 1992

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U.S. Department of Agriculture
Food and Nutrition Service
Office of Analysis and Evaluation
3101 Park Center Drive
Alexandria, VA 22302

Contract No. 53-3198-0-033
Contract Amount $722,601
Fully Competitive

Project Officer: Janet Tognetti

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ACKNOWLEDGEMENTS

Rick Williams, who served as RTI project manager for the WIC Modeling and Analytic Projects (MAP), is thanked for overall project direction and useful comments on earlier drafts. Namvar Zohoori provided research and computational assistance.

Several staff of the Food and Nutrition Service (FNS) were involved in this research. Janet Tognetti served as FNS project officer, and helped shape the final presentation of the report. Others in the Office of Analysis and Evaluation, including Jay Hirschman, Fran Zorn and Jeffrey Wilde assisted in the review process of the report. Donna Blum and Brenda Lisi of the Nutrition Technical Services Division, and Ron Vogel and Francesca Bravo of the Supplemental Food Program Divsion all served as reviewers of the report.

THE WIC BREASTFEEDING REPORT: THE RELATIONSHIP OF WIC PROGRAM PARTICIPATION TO THE INITIATION AND DURATION OF BREASTFEEDING

EXECUTIVE SUMMARY

This study employs descriptive and multivariate statistical techniques to model the determinants of breastfeeding initiation and duration among prenatal WIC participants and nonparticipants using cross-sectional data from the 1988 National Maternal and Infant Health Survey. In contrast to previous research, this study explicitly corrects for unmeasured differences between WIC participants and income-eligible nonparticipants (usually referred to as selection bias), in addition to controlling for other socioeconomic and demographic factors that are frequently found to be associated with breastfeeding, including mothers' and fathers' ages, education, race and family income.

Descriptive analysis revealed that the rate of breastfeeding initiation among women who were not income-eligible was higher than for women who were income-eligible but not participating in WIC. Income-eligible nonparticipants, in turn, had a higher rate of breastfeeding initiation than prenatal WIC participants. Thirty-seven percent of prenatal WIC participants initiated breastfeeding. The mean duration of breastfeeding for these women was 1.19 months.

Although causal relationships cannot be identified using data and methods as these, multivariate analysis revealed a number of statistically significant associations which may provide interesting hypotheses for future research:

- *After controlling for socioeconomic differences, prenatal WIC participants and eligible nonparticipants had comparable rates of breastfeeding initiation.*

- *Although the overall rate of breastfeeding was lower among prenatal WIC participants, those who reported having received advice to breastfeed their babies were more likely to initiate breastfeeding than income-eligible nonparticipants.*

- *Prenatal WIC participants who did not report having received advice to breastfeed were less likely to initiate breastfeeding than income-eligible nonparticipants.*

- *Maternal age, race, education, and location of residence were also associated with the likelihood of initiating breastfeeding.*

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- *Although the overall rate of breastfeeding was lower among prenatal WIC participants, those who reported having received advice to breastfeed their babies were more likely to initiate breastfeeding than income-eligible nonparticipants.*

- *Prenatal WIC participants who did not report having received advice to breastfeed were less likely to initiate breastfeeding than income-eligible nonparticipants.*

- *Maternal age, race, education, and location of residence were also associated with the likelihood of initiating breastfeeding.*

- *For women who initiated breastfeeding, neither prenatal WIC participation nor the reported receipt of advice to breastfeed were associated with breastfeeding duration.*

- *Factors associated with the duration of breastfeeding include maternal age, ethnicity, location of residence, and living situation.*

These findings suggest that WIC participation, and WIC nutrition education in particular, may play an important role in womens' infant feeding decisions. However, while encouraging, these findings should not be interpreted as evidence of a causal relationship between WIC participation and breastfeeding. Nor can these data provide support for the effectiveness of any specific method of breastfeeding promotion.

The lack of an association between WIC participation and breastfeeding duration should not be interpreted as evidence that nutrition education and breastfeeding promotion in particular do not, or cannot, increase the duration of breastfeeding.

In the past, most breastfeeding promotion efforts have focused on communicating the benefits of breastfeeding to mothers during the prenatal period. In recent years, there has been increasing recognition of the role of breastfeeding instruction and support during the early postpartum period. Other factors not examined in this analysis may also affect the initiation and duration of breastfeeding.

This analysis was derived from a retrospective cross-sectional survey which does not have sufficient data to explore potential biases that may have affected mothers' responses. For example, WIC clinics in 1988 may have selectively provided breastfeeding advice only to those who expressed an interest in it, and who presumably intended to breastfeed. Alternatively, WIC clinics may have provided breastfeeding advice to all participants, but the receipt of such advice may have been selectively reported only by those who chose to act on it. It is also important to note that this analysis is based on 1988 data. Since then, legislative changes outlined in PL 101-147 have placed renewed emphasis on breastfeeding promotion in the WIC Program.

This study suggests that more research is needed to investigate WIC's role in breastfeeding initiation and duration, and to identify appropriate strategies for approaching each of these distinct breastfeeding promotion objectives.

1. INTRODUCTION

WIC PROGRAM OVERVIEW

The Special Supplemental Food Program for Women, Infants and Children (WIC) is a Federal food assistance program. WIC provides supplemental foods, nutrition education and referral to health services to low-income pregnant, breastfeeding and non-breastfeeding postpartum women; infants; and preschool children up to 5 years of age who are at nutritional risk. The WIC Program is specifically designed to counter the effects of inadequate nutritional patterns, which greatly increase the risk of adverse health outcomes for these groups. Nutrition intervention during critical periods of growth and development, such as pregnancy, infancy, and early childhood, reduces the occurrence of related health problems and improves the overall health status of WIC participants.

WIC PROGRAM OPERATIONS

The WIC Program is administered by the Food and Nutrition Service (FNS) of the U.S. Department of Agriculture (USDA). The WIC organizational structure includes 7 FNS regional offices, 87 State agencies (including Indian agencies and U.S. territorial agencies), and about 1,700 local sponsoring agencies with varying numbers of service sites.

Program Eligibility

Federal legislation established three criteria for WIC eligibility. First, participants must belong to one of the following categories: pregnant women, breastfeeding women up to twelve months after delivery, non-breastfeeding women up to six months after delivery, infants up to one year of age, and children up to five years of age.

Second, the gross family income of WIC participants must meet specified guidelines. The maximum allowable WIC family income is 185 percent of the Office of Management and Budget (OMB) nonfarm-income poverty guidelines. State or local agencies may establish more stringent income standards, provided they are not less than 100 percent of the OMB poverty level. In addition, modified income requirements must correspond to the State's income standards for free or reduced-price health care.

Finally, WIC participants must be assessed by a competent health professional and qualify as nutritionally at risk. Section 17 of the Child Nutrition Act of 1966, as amended, (42 U.S.C. 1786) defines nutritional risk as one of the following:

- detrimental or abnormal nutritional conditions detectable by biochemical or anthropometric measurements;
- other documented nutritionally related medical conditions;
- dietary deficiencies that impair or endanger health; and
- conditions such as alcoholism or drug addiction that make an individual more likely to have inadequate nutritional patterns or nutritionally related medical problems.

A seven-level priority system for nutritional risk criteria was established by program regulations to ensure that program benefits are provided to those applicants in greatest nutritional need. When funding is not sufficient to provide benefits to all eligible persons, the priority system targets benefits to the most vulnerable individuals. The priority system is also applied to persons waiting to fill vacancies in agencies that have reached their maximum caseload.

Program Benefits

WIC Program benefits include supplemental food packages, nutrition and drug education, and referral to appropriate, accessible health services.

Supplemental food packages, or vouchers for food packages, are distributed to WIC participants free of charge. Food packages are individualized, and different food packages are available to different categories of participants. For example, participating infants 0-4 months of age only receive infant formula. Maximum food package quantities are set for each category of participant.

The food packages are designed to supplement the specific nutritional requirements of the following groups of program participants:

- infants through three months of age;
- infants four through twelve months of age;
- children/women with special dietary needs;
- children one to five years of age;
- pregnant and breastfeeding women; and

- non-breastfeeding postpartum women.

The WIC food packages provide nutrients, such as high-quality protein, iron, calcium, and Vitamins A and C, that are likely to be lacking in the diets of each group. Federal regulations specify maximum food package quantities for each category of participant. Within these guidelines, State and local agencies may elect to tailor the contents of their food packages, based on their nutritional policies and the specific needs of their WIC participants.

Local health or nutrition professionals, dietitians and nutritionists, usually provide nutrition education to WIC participants, including breastfeeding advice and promotion. Sometimes (about 10 percent of the time) nutrition education is provided by paraprofessionals. Nutrition education is designed to help participants improve their dietary habits and better utilize the supplemental foods provided by the WIC Program.

The WIC Program officially encourages breastfeeding among participants through its policies and program interventions. This encouragement or "promotion" can take a variety of forms because States have a great deal of flexibility in determining how to promote breastfeeding, when to promote it, and how to promote it. Because of the flexibility permitted in the Program, there is a great deal of variability in breastfeeding promotion practices among the States, and many unanswered questions about how it is carried out at the local level.

STUDY GOALS

Through nutrition education, breastfeeding promotion and food packages provided to lactating mothers, the WIC Program encourages breastfeeding. The WIC Program also encourages breastfeeding through the priority system. For example, postpartum breastfeeding women are a higher priority for certification than non-breastfeeding postpartum. Postpartum breastfeeding women are also eligible to remain on the Program longer than non-breastfeeding women.

The WIC Program effort follows closely the recommendation, from the American Academy of Pediatrics and various nutrition and public health associations, that breast milk is the ideal food for the infant, particularly during the first 4 to 6 months of life. Moreover, the Surgeon General has established target breastfeeding rates for all U.S. women for the Year 2000.

Despite the interest and concern that WIC Program managers and staff at all levels have shown for promoting breastfeeding, the extent and duration of breastfeeding among WIC recipients is still of concern. This study is designed to assist the WIC Program in determining breastfeeding behavior among its participants.

WIC Program planners and implementors aim to understand why mothers in the WIC Program may have a lower incidence of breastfeeding than mothers in the general population. This study examines the determinants of why mothers, both prenatal WIC participants and income-eligible nonparticipants, choose a type of infant feeding pattern.

Specifically, the major objectives of this study are to:

- describe the demographic and socio-economic characteristics of prenatal WIC participants, income-eligible nonparticipants, and other (higher income) nonparticipants associated with breastfeeding incidence and duration; and

- systematically examine the determinants of breastfeeding initiation and duration, especially the effect of prenatal participation in the WIC Program.

CONTENT AND ORGANIZATION OF THE REPORT

Chapter 1 describes the background of the WIC Program, briefly summarizes program operation and benefits, and identifies the goals of this study. Chapter 2 gives the background for the study in terms of U.S. breastfeeding trends, the WIC Program and breastfeeding, and recent research findings. Chapter 3 describes the data used in the study, and includes results from the descriptive analysis of the data. Chapter 4 describes the multivariate model and presents the results of the multivariate analysis, including estimation results and simulation results. Three appendices contain a technical description of the multivariate model, a discussion of alternative model specifications, and the results of an alternative breastfeeding estimation.

2. BACKGROUND

INTRODUCTION

There has been relatively little systematic investigation of the full range of socio-economic and demographic determinants of breastfeeding behavior in the United States, and the field is still considered an emerging research area. Many of the previous studies use small data sets, and a major criticism of most studies is that breastfeeding behavior is not clearly defined. Very little research has been conducted on the effect of participation in the WIC Program on breastfeeding behavior. One recent study (Ryan et al., 1991b) did attempt to examine the effect of the WIC Program on breastfeeding behavior, but the analysis was not based on nationally representative data, and failed to control for sample selection of participation in the WIC Program.

The study presented in this report is based on a nationally representative data base, and also considers the effect of WIC breastfeeding advice on subsequent breastfeeding behavior. Moreover, this study is the first known to systematically control for WIC sample selection in the analysis of breastfeeding behavior.

BREASTFEEDING TRENDS

There have been three distinct breastfeeding trends in the post World War II period in the United States. First, from 1946 to the early 1970's, there was a decline in the extent of breastfeeding (Meyer et al., 1968; Hendershot, 1984). The end of this downward trend differs between surveys by a few years (e.g., Ryan et al., 1991a). The second breastfeeding trend was an increase, in fact a more than doubling, of the proportion of women initiating breastfeeding between the early 1970's and 1982. The third trend, beginning in the early 1980's, rates peaked and they have steadily declined since then (Ryan et al., 1991b).[1]

These three trends have been quite consistent for most socio-demographic groupings and where data has been published for both exclusive and mixed breastfeeding (e.g., Fetterly et al., 1984). In general, breastfeeding appears to be related to socio-demographic characteristics, but the reasons for these relationships are not clearly understood.

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[1]Similar declines have been documented in other population-based studies from the United Kingdom (Emery, et al., 1990).

Infant-feeding practices have tended to change first among better educated and higher income mothers. The decline in the post World War II period was very rapid. In the period 1936 to 1940, over 77 percent of the infants were breastfed for a mean duration of over 4 months. The incidence declined to about 25 percent by 1970 and the duration was cut in half. Rates fell most sharply among Blacks (Hirschman and Butler, 1981). Whereas before 1960, Black mothers were more likely to breastfeed, after that period this situation reversed and White mothers breastfed more. Higher educated women reduced their rates more rapidly.

The large reversal of this trend in the 1970's is documented in both nationwide surveys and the market surveys of Ross Laboratories. The increase in breastfeeding initiation occurred among all socio-demographic groups but was greatest among Whites (Hendershot, 1976). The best data for Hispanics comes from the Hispanic HANES survey conducted in the 1982-84 period. From 1970 to 1982 breastfeeding initiation among Hispanics increased from about 30 percent to over 47 percent (John and Martorell, 1989).

This increase peaked in the early 1980's and there has been a steady decline in breastfeeding since then. Today about 58 percent of White mothers, 23 percent of Black mothers, and 48 percent of Hispanic mothers initiate breastfeeding, and all have a shorter duration of breastfeeding compared to the earlier period. Breastfeeding initiation rates are higher, and breastfeeding duration longer, among high income and better educated women.

THE WIC PROGRAM AND BREASTFEEDING

Since its inception, considerable interest and controversy has surrounded the effects of the WIC Program on infant feeding patterns, particularly the initiation and duration of breastfeeding. Over the years questions such as whether the WIC Program provides incentives for mothers to formula or mix-feed their infants, and whether the WIC Program provides adequate education and incentives to encourage lactation, have abounded (e.g., Popkin et al., 1981).

Breastfeeding by WIC Program mothers probably always was of some concern in the WIC Program, but the level of concern is likely to have grown along with the Program because of the ever larger number of women being served, and the growing share of the infant formula market that is accounted for by the WIC Program.

As Michael Kramer noted in a recent editorial in Pediatrics, the WIC Program offers "a unique window of opportunity for promotion of breastfeeding among the nation's poor" (Kramer, 1991, page 399). Over the past decade, there has been increasing effort by the U.S. Department of Agriculture (USDA) to promote breastfeeding. This has included the establishment of regulatory provisions to encourage WIC mothers to breastfeed, the development of a number of demonstration projects and of education materials which are provided to each local WIC agency, and participation of the WIC Program in cooperative efforts with other U.S. government activities designed to encourage breastfeeding such as the Healthy Mothers, Healthy Babies Coalition.

Through its present nutrition education programs and literature included with the food package provided for pregnant, and breastfeeding and non-breastfeeding postpartum women, the WIC Program has tried to encourage breastfeeding. This effort follows closely the recommendation, from the American Academy of Pediatrics and various nutrition and public health associations, that breast milk is the ideal food for the infant, particularly during the first 4 to 6 months of life.

The WIC Program officially encourages breastfeeding among participants through its policies and program interventions. This encouragement or "promotion" can take a variety of forms because States have a great deal of flexibility in determining how to promote breastfeeding, and when to promote it. Because of the flexibility permitted in the Program, there is a great deal of variability in breastfeeding promotion practices among States, and many unanswered questions about how it is carried out at the local level.

Based on legislative changes outlined in PL 101-147, USDA published new regulations to promote breastfeeding in mid-1990. Moreover, WIC Program sites are now required to promote breastfeeding (in some fashion) as part of nutrition education, and a small part of each State Agency's WIC grant is earmarked for breastfeeding promotion.

Despite all these activities it is not clear if participation in the WIC Program increases likelihood that a mother breastfeeds her baby, or increases the length of time that a mother breastfeeds. Systematic evaluations of the effect of WIC Program participation on the initiation and duration of breastfeeding are lacking. In addition, serious flaws exist in the few studies on national samples which have examined the effect of WIC Program participation on this crucial feeding behavior.

It is essential to compare women who are on WIC with women who are comparable in every respect except for not participating in WIC. The difficulty is in defining that comparison group.

There are several difficulties associated with the study of the relationship between WIC participation and breastfeeding. These include: 1) potential selection bias; 2) WIC participation may be correlated with background characteristics that are associated with a lower incidence of breastfeeding; and 3) the WIC Program makes infant formula available to participants.

RECENT RESEARCH FINDINGS

A recent study of United States trends in breastfeeding, sponsored by Ross Laboratories and using Ross market surveys, compared breastfeeding patterns for U. S. mothers in 1984 and 1989, and examined factors responsible for both the pattern of breastfeeding in 1989 and for the downward trend in the proportion of mothers breastfeeding their babies in the hospital and at 6 months (Ryan et al., 1991b).

Women who were Black, women who were enrolled in the WIC Program, and women who had no more than high school education were less likely to initiate breastfeeding. While the factors influencing the decline in breastfeeding were not uniform, enrollment in the WIC Program was found to be associated with a steeper decline in breastfeeding both in the hospital and at six months than for those not enrolled in WIC (Ryan et al., 1991b).

There are a number of reasons why the Ross Laboratory survey results must be questioned. The data used in the study primarily is collected for market research. Perhaps the most important criticism of the study is that selectivity bias associated with enrollment in the WIC Program on breastfeeding behavior was not statistically controlled in the analysis. That is, the Ross analysis does not take into account unmeasured differences between WIC participants and nonparticipants that might affect breastfeeding behavior.

Selectivity bias is an important issue in all WIC research. Not all of those who are eligible for WIC actually choose to participate. Those who participate may differ from those who do not in ways that affect breastfeeding behavior. Thus, the result attributed to WIC participation obtained from the Ryan et al. (1991b) study may be biased because it does not take into account unmeasured differences between WIC participants and nonparticipants (Tognetti, et al., 1991).

The highly publicized Ross study has sparked renewed interest in understanding what the effects of WIC participation are and how WIC participation can be made to more effectively enhance breastfeeding behavior.

The study presented in this report overcomes the problems associated with previous research by using a multivariate analysis method that corrects for selectivity bias, and uses a recently released nationally representative data base with components designed to specifically address the effect of the WIC Program on various outcomes.

This study provides information on the breastfeeding practices of prenatal WIC participants, income-eligible nonparticipants, and other higher income nonparticipants. For income-eligible mothers, both prenatal WIC participants and nonparticipants, it examines the determinants of breastfeeding initiation and duration. The determinants of breastfeeding initiation and duration examined include WIC participation, WIC Program breastfeeding advice, and other socio-demographic and economic background factors.

3. DATA AND DESCRIPTIVE PROFILES

NMIHS DATA

The data used for the analysis of breastfeeding behavior are drawn from the 1988 National Maternal and Infant Health Survey (NMIHS) conducted by the Department of Health and Human Services (DHHS), National Center for Health Statistics (NCHS), and cosponsored by a number of government agencies including USDA/FNS.

The NMIHS is a nationally representative, cross-sectional study of infant births and deaths and fetal deaths occurring in 1988. The sample frame consisted of three components: live birth certificates, infant death certificates, and fetal death reports.

Mothers were mailed questionnaires based on information from vital records. Mothers who responded to the questionnaire include 9,953 women who had live births, 3,309 women who had late fetal deaths, and 5,332 women who had infant deaths.

For the purposes of this study "breastfeeding" and "non-breastfeeding" behavior refers to whether the NMIHS mothers breastfed the index infant only. Whether the NMIHS mother breastfed any other of her infants is not considered.

For this study, whether mothers initiated breastfeeding is based on their response to an NMIHS question which asked "Did you ever breastfeed this baby?" For those women who initiated breastfeeding, the duration of breastfeeding is based on their response to the question "How old was your baby when you stopped breastfeeding?" The response rate for these two questions that were used to define breastfeeding initiation and duration is significantly higher, and therefore more reliable, than the response rate to an alternative set of NMIHS questions which asked how many times a day the baby was fed various foods, including breast milk, during each of the first six months following delivery. Because of the difference in response rates, breastfeeding analyses based on the alternative set of monthly feeding data from the NMIHS may yield results that differ from those presented in this study.

Response Rate

The overall response rate of the NMIHS was 71 percent; it was 74 percent for live birth mothers, 69 percent for fetal death mothers, and 65 percent for infant death mothers. Response rates differed according to mother's age, race, marital status, and educational attainment within the three birth outcomes. Mothers were more likely to respond if they

were: over 30 years old, White, married, and had at least a high school education.

Imputation

Imputation was performed by NCHS to create data that was missing due to item nonresponse (a particular question was not answered) using real data from a similar respondent. The "hot-deck" imputation procedure was done separately for live births, fetal deaths, and infant deaths. For example, if the father's age was missing, the mother's age and race were used as predictor items. Previous vital records in the file were searched for a similar mother. Once found, that father's age was inserted for the father's age on the missing record.

A total of 461 variables were imputed in the NMIHS. Of these, 299 were imputed in less than 1 percent of cases, 68 were imputed in 1 to 2 percent of cases, 71 were imputed in 2 to 5 percent of cases, 14 were imputed in 5 to 10 percent of cases, and 9 were imputed in more than 10 percent of cases.

Only two variables used for the multivariate analysis in this report, father's education and household income, had values imputed by NCHS. Only 5 to 10 percent of the observations on father's education were imputed. Household income was imputed in more than 10 percent of the cases.

Sample Design

The NMIHS drew stratified systematic samples from calendar year 1988 vital records from 48 States, the District of Columbia, and New York City. For live births, there were six sampling strata by race (Black, non-Black) and birthweight (< 1500 grams, 1500-2499 grams, 2500+ grams). For fetal deaths and infant deaths, there were only two strata by race. In order to assure a representative sample by such variables as age of mother and marital status, implicit stratification was used. That is, after the live birth records were stratified, further sorting of vital records was done by age of mother and marital status within each of the live birth strata. Similar sub-sorting was carried out for fetal and infant death records.

Because Black infants have rates of low-birthweight and infant mortality about twice as high as White infants, low- and very low-birthweight infants and Black infants were oversampled in the natality component of the NMIHS. In addition, Black infants were oversampled in the fetal death and infant death component to obtain a sufficient number of high-risk births for special studies.

Analysis Weights

In 1988, there were 3,898,922 live births to women between 15 and 49 years of age, 15,259 fetal deaths of 28 weeks or more gestation, and 38,917 infant deaths to U.S. residents. The overall probability of survey selection was about 1 of every 354 live births, 1 of every 4 fetal deaths, and 1 of every 6 infant deaths.

The survey data was weighted to reflect the national counts. Each record was assigned a final weight reflecting the overall probability of selection, after adjusting for sample design, nonresponse, and stratifying variables.

Complete detailed information on the NMIHS sample design, survey response rates, missing data, imputation, validation of data, estimation procedures, and variance estimation is available from NCHS (Public Use Data Tape Documentation, 1991).

STUDY SAMPLE

The NMIHS sample used for this analysis of breastfeeding behavior is from the first public use tape in which vital records are linked with mothers' questionnaires. The study sample consists of the 9,953 mothers who had live births in 1988. Data on mothers who had fetal and infant deaths are not used in the analysis that is reported here. Fetal deaths, obviously, can not be considered as candidates for breastfeeding by the mother. The causes of infant deaths may influence breastfeeding behavior and be a confounding factor for the analysis, and also pose serious censoring problems. Thus, data for mothers who had fetal and infant deaths are not included in this analysis.

Of the mothers who had live births, 6,170, or 62 percent, were income-eligible for participation in the WIC Program. After the sample was reduced due to missing values, the final sample size of income-eligible WIC mothers used in the multivariate analysis was 5,585. Almost all of the 585 missing values were due to missing breastfeeding information, the ultimate dependent variable. Thus, imputation for these data was not possible.

In order to minimize the problem associated with having imputed household income for over 10 percent of the NMIHS cases, households were assigned to income quintiles which are used as dummy variables in the multivariate analysis. The likelihood that a household has an incorrect income quintile is less than the likelihood that the imputation method incorrectly assigns household income. Thus, imputed values for household income should not seriously compromise the multivariate results.

SUPPLEMENTAL DATA

Additional data on the WIC Program was collected and used in the multivariate analyses to indicate differences in the coverage of the WIC Program by State of residence. Average monthly WIC Program expenditures in 1988 for food and Program administration were collected by State from FNS-149 Reports for FY 1988. State expenditures per capita for food and administration were calculated by dividing 1988 State populations from U.S. Bureau of the Census, Current Population Reports, Series P-25, as reported in the 1990 U.S. Statistical Abstract. These data are used in estimation of the multivariate selection bias model as a factor of WIC Program participation that does not directly affect breastfeeding.

DESCRIPTIVE STATISTICS AND ANALYSIS

Descriptive statistics (means, percentages, and standard errors), corrected for design effects, were calculated to provide profiles and comparisons of the characteristics of prenatal WIC participants, income-eligible nonparticipants, and other nonparticipants by "breastfeeders" and "non-breastfeeders." Life-table probabilities were computed for duration of breastfeeding.

For the purposes of this report, "breastfeeders" are defined as mothers who ever-breastfed the index infant; "non-breastfeeders" are defined as mothers who never breastfed the index infant. Breastfeeders may include both exclusive breastfeeders as well as those who mix breastfeeding and other infant foods.

The descriptive statistics are all based on weighted data from the 1988 NMIHS. The Survey Data Analysis Software System (SUDAAN) was used to produce nationally representative descriptive statistics to properly estimate the variance from the complex NMIHS survey design, stratification, clustering, and unequal weighting. Variance estimation in SUDAAN is based on the Taylor series linearization method.

Descriptive statistics do not control for complex multiple influences on breastfeeding behavior; they provide simple profiles of the characteristics of prenatal WIC participants, income-eligible nonparticipants, and other nonparticipants, according to whether they breastfeed or not.

It is important to emphasize that there are many possible reasons for observed differences in breastfeeding practice between prenatal WIC participants, income-eligible nonparticipants, and other nonparticipants. In addition to whether the individual participated in the WIC Program,

the background socio-economic characteristics, and other factors, of these three groups appear to be different.

It is only when all differences between individuals are fully controlled in a multivariate model, that an analysis can correctly assess whether prenatal WIC participation influences breastfeeding behavior. There are many possible reasons for observed differences in breastfeeding practice between prenatal WIC participants, income-eligible nonparticipants, and other nonparticipants. As noted below, the background socio-economic characteristics and other factors of these three groups appear to be different, in addition to whether the individual participated in the WIC Program.

Prenatal WIC Participants versus Non-Participants

Table 3.1 compares the characteristics of prenatal WIC participants, income-eligible nonparticipants, and other higher income nonparticipants. Characteristics that are compared include demographic and socio-economic characteristics of the mother, father, and household.

On average, prenatal WIC participants tend to be younger and less educated than income-eligible nonparticipants and other nonparticipants. In addition, a higher percentage of WIC participants are Black and Hispanic, not married, not living with the baby's father, not employed in the previous year, and covered by Medicaid for prenatal care and/or delivery than income-eligible nonparticipants or other nonparticipants.

These comparisons suggest that the WIC Program serves individuals who are disadvantaged on average, even relative to the rest of the income-eligible target population. Nonetheless, fully 54 percent of WIC participants had worked in the 12 months prior to delivery (compared to 61.9 percent of income-eligible nonparticipants and 78.8 percent of other pregnant women). In addition, 91 percent of WIC participants who lacked private health coverage were covered by Medicaid (compared to only 65.9 percent of income-eligible nonparticipants and 5.8 percent of other pregnant women).[2]

The characteristics of the fathers of these women's babies showed similar patterns: the fathers of the WIC participants's babies were

[2]As shown in Table 3.1, of the 60.7 percent of prenatal WIC participants without private insurance during pregnancy, 55.1 percent were covered by Medicaid for prenatal care and/or delivery. That is, 91 percent of those without private insurance (55.1 percent divided by 60.7 percent) were covered by Medicaid.

Table 3.1. Comparison of Prenatal WIC Participants, Income-Eligible Nonparticipants, and Other Nonparticipants

	Prenatal WIC Participants	Income-Eligible Nonparticipants	Other Nonparticipants
Mother's Characteristics			
Mean Age (in years)	23.4	25.0	28.4
Age (% distribution)			
Under 18	10.8	5.3	1.0
18 - 19	14.6	12.1	2.1
20 - 24	38.9	33.3	18.8
25 - 29	22.2	27.9	38.5
30 - 34	9.5	15.7	28.5
35 and over	4.0	5.7	11.2
Education (% distribution)			
8 years or less	8.7	7.7	0.9
9 - 11 years	30.9	19.2	3.8
High school graduate	43.3	45.0	34.8
Some college	14.7	20.6	30.7
College graduate	2.5	7.6	29.8
Race (% distribution)			
White	64.0	73.3	88.9
Black	31.5	22.1	5.7
Asian or Pacific Islander	2.0	3.3	4.7
Native American	2.5	1.3	0.6
Percent Hispanic	20.3	15.7	7.7
Percent married	48.0	64.3	93.0
Percent who lived with the baby's father during most of the pregnancy	59.6	73.2	95.3
Percent employed at any time during 12 months prior to delivery	54.0	61.9	78.8
Percent covered by Medicaid for prenatal care and/or delivery	55.1	29.2	0.5
Percent without private insurance during pregnancy	60.7	44.3	8.6

Table 3.1. Comparison of Prenatal WIC Participants, Income-Eligible Nonparticipants, and Other Nonparticipants (continued)

	Prenatal WIC Participants	Income-Eligible Nonparticipants	Other Nonparticipants
Father's Characteristics			
Mean Age (in years)	27.9	29.0	32.0
Age (% distribution)			
Under 18	0.4	0.2	0.0
18 - 19	4.0	3.8	0.4
20 - 24	29.9	22.6	6.5
25 - 29	33.1	31.3	27.4
30 - 34	18.6	23.3	36.3
35 and over	14.1	18.8	29.4
Education (% distribution)			
8 years or less	9.5	8.4	0.9
9 - 11 years	24.0	16.7	4.6
High school graduate	50.7	46.1	34.2
Some college	12.3	18.7	22.9
College graduate	3.5	10.2	37.4
Race (% distribution)			
White	60.9	72.2	89.1
Black	33.6	23.0	6.1
Asian or Pacific Islander	2.0	2.9	4.2
Native American	3.5	2.0	0.7
Percent Hispanic	21.9	16.1	6.7
Percent employed at any time during 12 months prior to delivery	84.3	88.9	98.4
Household Characteristics			
Mean household size	4.0	4.0	3.0
Percent living in a non-metropolitan county	32.6	23.7	17.8
Percent currently receiving AFDC	37.0	21.9	0.9
Percent currently receiving food stamps	45.0	24.2	1.0

Table 3.1. Comparison of Prenatal WIC Participants, Income-Eligible Nonparticipants, and Other Nonparticipants (continued)

	Prenatal WIC Participants	Income-Eligible Nonparticipants	Other Nonparticipants
Mean annual pre-tax income ($)	12,564	13,266	40,029
Mean annual pre-tax income per household member ($)	3,858	3,851	15,015
Pre-tax income as % of the poverty level:			
100 or less	56.2	45.2	0.0
101 - 150	17.2	25.6	0.0
151 - 185	8.5	21.0	0.0
186 - 250	8.7	2.8	15.8
over 250	9.6	5.5	84.2
Percent with any income from the following sources during 12 months prior to delivery:			
Wages, salaries, interest, or dividends	74.8	85.4	99.7
AFDC	34.1	21.4	0.0
Food Stamps	38.0	21.8	0.0
Housing assistance or public housing	8.6	5.9	0.3
Social Security or SSI	8.6	7.5	0.8
Unemployment Insurance	4.8	5.8	2.1
Veteran's benefits	1.5	3.0	0.5
Child Support/alimony from absent parent	5.5	6.8	2.0
Sample Size	3,868	2,302	3,783

Data Source: 1988 National Maternal and Infant Health Survey.

Note: Means and percent distributions are based on weighted data and are calculated using SUDAAN.

younger and less educated than the fathers of the babies of income-eligible nonparticipants and other nonparticipants. Also, a higher percentage are Black or Hispanic, and not employed for a portion of the previous year than the fathers of the babies of income-eligible nonparticipants and other nonparticipants.

Prenatal WIC participants and income-eligible nonparticipants statistically were not significantly different in terms of household size or mean household income, but prenatal WIC participants were more likely to depend on public assistance income. In addition, a larger proportion of WIC participants had incomes below the poverty level than income-eligible nonparticipants (56.2 percent versus 45.2 percent).

Even though the maximum allowable WIC family income is 185 percent of the OMB nonfarm-income poverty guidelines, some prenatal WIC participants and income-eligible nonparticipants reported household income above the allowable level. This apparent anomaly is likely to be caused by simple reporting error, the timing of the survey, and inclusion of other welfare program payments in household income. Some prenatal WIC participants may have had household income above the allowable WIC level at the time of the survey (during the postpartum period). These prenatal WIC participants would have been ineligble for postpartum WIC participation. Income-eligible nonparticipants may have reported household income which includes Medicaid and AFDC payments.

WIC participants were less likely to live in metropolitan counties than income-eligible nonparticipants, suggesting that WIC reaches a larger proportion of the income-eligible population in rural areas.

Breastfeeders versus Non-Breastfeeders

Descriptive statistics are calculated for mothers, fathers, and households by whether the mother breastfed or not, for prenatal WIC participants, income-eligible nonparticipants, and other nonparticipants. Statistics are given for mother's characteristics (age, education, race, ethnicity, marital status, prenatal care, use of alcohol, cigarettes, cocaine, and marijuana during pregnancy, depression scale), father's characteristics (age, education), one child's characteristic (sex), and household characteristics (size, use of daycare). Means, percent distributions, standard errors, and sample frequencies for each characteristic are calculated for breastfeeders and non-breastfeeders.

Table 3.2 presents statistics that compare the characteristics of prenatal WIC participants by breastfeeders and non-breastfeeders. Note that

Table 3.2. Comparison of Breastfeeders and Non-Breastfeeders: Prenatal WIC Participants

	Breastfeeders	Non-Breastfeeders
Prenatal WIC Participants (row %)	37.35 (1.76)	62.65 (1.76)
Mother's Characteristics		
Age (mean, in years) [3868]	24.40 (0.24)	22.79 (0.15)
Education (row %):		
8 years or less [214]	36.04 (4.53)	63.96 (4.53)
9-11 years [1222]	29.98 (2.20)	70.02 (2.20)
High school graduate [1703]	36.49 (1.88)	63.51 (1.88)
Some college [627]	51.84 (3.10)	48.17 (3.10)
College graduate [102]	63.47 (6.82)	36.53 (6.82)
Race (row %):		
White [1107]	44.28 (1.80)	55.72 (1.80)
Black [2671]	19.80 (0.87)	80.20 (0.87)
Asian or Pacific Islander [42]	52.96 (9.87)	47.04 (9.87)
Other [48]	67.54 (8.27)	32.46 (8.27)
Hispanic (row %) [389]	50.77 (3.22)	49.23 (3.22)
Married (row %) [1431]	44.57 (1.85)	55.43 (1.85)
Prenatal Care:		
Yes (row %) [3791]	37.43 (1.25)	62.57 (1.25)
Number of Visits (mean) [3868]	11.06 (0.22)	10.45 (0.14)
Use of Alcohol During Pregnancy (row %) [1067]	44.23 (2.38)	55.41 (2.38)
Use of Cigarettes During Pregnancy (row %) [1257]	31.61 (2.08)	68.40 (2.08)
Use of Cocaine/Crack During Pregnancy (row %) [90]	44.16 (8.97)	55.84 (8.97)
Use of Marijuana During Pregnancy (row %) [239]	44.23 (5.12)	55.78 (5.12)
Depression Scale (mean) [3868]	12.63 (0.47)	15.07 (0.35)

Table 3.2. Comparison of Breastfeeders and Non-Breastfeeders:
Prenatal WIC Participants
(continued)

	Breastfeeders	Non-Breastfeeders
Father's Characteristics		
Age (mean, in years) [3868]	29.07 (0.29)	27.21 (0.18)
Education (row %):		
8 years or less [209]	42.80 (4.50)	57.20 (4.50)
9-11 years [874]	31.21 (2.57)	68.79 (2.57)
High school graduate [2088]	34.79 (1.71)	65.21 (1.71)
Some college [524]	51.90 (3.36)	48.10 (3.36)
College graduate [173]	50.63 (5.87)	49.38 (5.87)
Child's Characteristics		
Sex (row %):		
Male [1939]	36.21 (1.74)	63.79 (1.74)
Female [1929]	38.60 (1.78)	61.40 (1.78)
Household Characteristics		
Household Size (mean) [3868]	3.94 (0.09)	3.99 (0.06)
Use of Daycare (row %)*		
Formal [200]	44.37 (5.51)	55.63 (5.51)
Relatives [971]	35.57 (2.47)	64.43 (2.47)
Other [339]	46.43 (3.87)	53.57 (3.87)

Data Source: 1988 National Maternal and Infant Health Survey

* There is a significant number of observations with missing values in this category.

Note: Percent distributions are row percentages, that is, each row that contains percentages sums to 100 percent. Means, percent distributions, and standard errors are based on weighted data and are calculated using SUDAAN. Sample frequencies are given in brackets [ ]. Standard errors are given in parentheses ( ).

percent distributions in Table 3.2 (as well as in Tables 3.3 and 3.4) are row percentages. That is, each row that contains percentages sums to 100 percent. For example, the third row in Table 3.2 indicates that of the 214 prenatal WIC participants with 8 years of education or less, 36.04 were breastfeeders, and 63.96 were non-breastfeeders.

The results indicate that among prenatal WIC participants, only 37.35 percent are breastfeeders. For both male and female infants, breastfeeding is less prevalent than non-breastfeeding. Only about 36 percent of male infants, and about 39 percent of female infants, who mothers participated in the WIC Program during the prenatal period are breastfed.

In general, the statistics in Table 3.2 reveal that for nearly all categories of characteristics of prenatal WIC participants, a higher percentage are non-breastfeeders than breastfeeders. A few exceptions are:

- a higher percentage of prenatal WIC participants who have some college, or who are college graduates, are breastfeeders; and

- a higher percentage of prenatal WIC participants who are Asian or Pacific Islander, classified as Other race, and Hispanic are breastfeeders.

Prenatal WIC participants who are non-breastfeeders have a slightly lower average age, slightly smaller average number of prenatal visits, and higher average (self-reported) depression scale index.

Fathers of babies whose non-breastfeeding mother was a prenatal WIC participant have a slightly lower average age and, similar to mothers, a higher percentage of fathers with just high school educations, or lower, had children who were not breastfed.

For income-eligible nonparticipants (Table 3.3), the profile is very similar as that found for prenatal WIC participants. Similar to women who were prenatal WIC participants, a lower percentage of income-eligible nonparticipants (44.44 percent) are breastfeeders compared to non-breastfeeders (55.56 percent). Only about 43 percent of male infants and about 46 percent of female infants are breastfed.

Compared to prenatal WIC participants, a few differences are found for income-eligible nonparticipants. As noted in each of the following cases, the opposite was found for prenatal WIC participants:

Table 3.3. Comparison of Breastfeeders and Non-Breastfeeders: Income-Eligible Nonparticipants

	Breastfeeders	Non-Breastfeeders
Income-Eligible Nonparticipants (row %)	44.44 (2.31)	55.56 (2.31)
Mother's Characteristics		
Age (mean, in years) [2302]	25.83 (0.28)	24.42 (0.22)
Education (row %):		
8 years or less [138]	43.51 (6.26)	56.49 (6.26)
9-11 years [553]	25.03 (3.32)	74.98 (3.32)
High school graduate [1032]	40.87 (2.44)	59.13 (2.44)
Some college [454]	58.98 (3.40)	41.02 (3.40)
College graduate [125]	76.19 (5.12)	23.81 (5.12)
Race (row %):		
White [868]	50.72 (2.09)	49.28 (2.09)
Black [1350]	20.16 (1.29)	79.85 (1.29)
Asian or Pacific Islander [56]	59.78 (9.21)	40.22 (9.21)
Other [28]	42.26 (14.40)	57.74 (14.40)
Hispanic (row %) [231]	44.37 (4.44)	55.63 (4.44)
Married (row %) [1045]	53.21 (2.08)	46.79 (2.08)
Prenatal Care:		
Yes (row %) [2077]	45.18 (1.68)	54.82 (1.68)
Number of Visits (mean) [2302]	10.70 (0.22)	9.46 (0.17)
Use of Alcohol During Pregnancy (row %) [775]	49.59 (2.74)	50.41 (2.74)
Use of Cigarettes During Pregnancy (row %) [803]	36.77 (2.75)	63.24 (2.75)
Use of Cocaine/Crack During Pregnancy (row %) [117]	33.26 (10.03)	66.75 (10.03)
Use of Marijuana During Pregnancy (row %) [147]	52.76 (6.84)	47.24 (6.84)
Depression Scale (mean) [2302]	10.30 (0.48)	12.62 (0.45)

Table 3.3. Comparison of Breastfeeders and Non-Breastfeeders: Income-Eligible Nonparticipants (continued)

	Breastfeeders	Non-Breastfeeders
Father's Characteristics		
Age (mean, in years) [2302]	29.87 (0.33)	28.43 (0.26)
Education (row %):		
8 years or less [140]	34.81 (5.88)	65.19 (5.88)
9-11 years [410]	28.00 (3.78)	72.00 (3.78)
High school graduate [1188]	41.73 (2.37)	58.27 (2.37)
Some college [400]	56.69 (3.69)	43.32 (3.69)
College graduate [164]	68.35 (4.68)	31.65 (4.68)
Child's Characteristics		
Sex (row %):		
Male [1179]	42.63 (2.25)	57.37 (2.25)
Female [1123]	46.49 (2.38)	53.51 (2.38)
Household Characteristics		
Household Size (mean) [2302]	3.95 (0.12)	4.07 (0.08)
Use of Daycare (row %):*		
Formal [115]	50.17 (6.89)	49.83 (6.89)
Relatives [548]	44.82 (3.18)	55.18 (3.18)
Other [211]	53.78 (4.77)	46.22 (4.77)

Data Source: 1988 National Maternal and Infant Health Survey.

* There is a significant number of observations with missing values in this category.

Note: Percent distributions are row percentages, that is, each row that contains percentages sums to 100 percent. Means, percent distributions, and standard errors are based on weighted data and are calculated using SUDAAN. Sample frequencies are given in brackets [ ]. Standard errors are given in parentheses ( ).

- a higher percentage of White income-eligible nonparticipants are breastfeeders than non-breastfeeders (a higher percentage of White prenatal WIC participants are non-breastfeeders than breastfeeders);

- a higher percentage of Hispanic income-eligible nonparticipants are non-breastfeeders than breastfeeders (a higher percentage of Hispanic prenatal WIC participants are breastfeeders than non-breastfeeders);

- a higher percentage of married income-eligible nonparticipants are breastfeeders than non-breastfeeders (a higher percentage of married prenatal WIC participants are non-breastfeeders than breastfeeders); and

- a higher percentage of income-eligible nonparticipants who used marijuana are breastfeeders than non-breastfeeders (a higher percentage of prenatal WIC participants who used marijuana are non-breastfeeders than breastfeeders).

There are also differences between prenatal WIC participants and income-eligible nonparticipants in types of daycare used. For prenatal WIC participants, a larger percentage of households who use all types of daycare (formal, relatives, other) are non-breastfeeders. For income-eligible nonparticipants, only those who use relatives for day care have a higher percentage who are non-breastfeeders.

Significant differences exist between the profiles of other (higher income) nonparticipants (Table 3.4) and prenatal WIC participants and income-eligible nonparticipants with respect to breastfeeding. Generally, the prevalence of breastfeeding in these (higher income) families is significantly higher. In these higher income families, about 66 percent of male infants and about 65 percent of female infants are breastfed.

The average age of mothers and fathers of other nonparticipant households is older when compared to prenatal WIC participant and income-eligible nonparticipant families. Also, the average household size during the pregnancy for other nonparticipant families (about 3 individuals) is smaller than for either prenatal WIC participant families or income-eligible nonparticipant families (about 4 individuals).

Table 3.4. Comparison of Breastfeeders and Non-Breastfeeders: Other Nonparticipants

	Breastfeeders	Non-Breastfeeders
Other Nonparticipants (row %)	65.53 (1.34)	34.47 (1.34)
Mother's Characteristics		
Age (mean, in years) [3783]	28.89 (0.12)	27.31 (0.17)
Education (row %):		
8 years or less [33]	35.30 (10.73)	64.70 (10.73)
9-11 years [148]	52.47 (5.24)	47.53 (5.24)
High school graduate [1285]	52.64 (1.71)	47.36 (1.71)
Some college [1208]	67.34 (1.69)	32.66 (1.69)
College graduate [1109]	81.29 (1.40)	18.71 (1.40)
Race (row %):		
White [2702]	65.99 (1.03)	34.01 (1.03)
Black [899]	46.75 (1.94)	53.26 (1.94)
Asian or Pacific Islander [158]	80.85 (3.68)	19.15 (3.68)
Other [24]	55.62 (12.91)	44.38 (12.91)
Hispanic (row %) [270]	60.79 (3.67)	39.21 (3.67)
Married (row %) [3392]	65.96 (0.98)	34.04 (0.98)
Prenatal Care:		
Yes (row %) [3748]	65.53 (0.95)	34.47 (0.95)
Number of Visits (mean) [3783]	12.21 (0.09)	11.83 (0.12)
Use of Alcohol During Pregnancy (row %) [1960]	69.70 (1.24)	30.30 (1.24)
Use of Cigarettes During Pregnancy (row %) [926]	53.61 (2.07)	46.39 (2.07)
Use of Cocaine/Crack During Pregnancy (row %) [36]	59.23 (9.51)	40.77 (9.51)
Use of Marijuana During Pregnancy (row %) [144]	56.27 (5.03)	43.73 (5.03)
Depression Scale (mean) [3783]	7.44 (0.20)	9.00 (0.31)

Table 3.4. Comparison of Breastfeeders and Non-Breastfeeders: Other Nonparticipants (continued)

	Breastfeeders	Non-Breastfeeders
Father's Characteristics		
Age (mean, in years) [3783]	32.62 (0.14)	30.81 (0.18)
Education (row %):		
8 years or less [34]	63.10 (10.42)	36.90 (10.42)
9-11 years [173]	45.71 (4.85)	54.29 (4.85)
High school graduate [1368]	52.93 (1.72)	47.07 (1.72)
Some college [927]	68.14 (1.92)	31.86 (1.92)
College graduate [1281]	77.93 (1.37)	22.08 (1.37)
Child's Characteristics		
Sex (row %):		
Male [1921]	66.16 (1.32)	33.84 (1.32)
Female [1862]	64.86 (1.38)	35.14 (1.38)
Household Characteristics		
Household Size (mean) [3783]	2.96 (0.03)	2.90 (0.03)
Use of Daycare (row %)*		
Formal [333]	65.06 (3.24)	34.94 (3.24)
Relatives [1047]	62.92 (1.83)	37.09 (1.83)
Other [922]	66.82 (1.85)	33.18 (1.85)

Data Source: 1988 National Maternal and Infant Health Survey.

* There is a significant number of observations with missing values in this category.

Note: Percent distributions are row percentages, that is, each row that contains percentages sums to 100 percent. Means, percent distributions, and standard errors are based on weighted data and are calculated using SUDAAN. Sample frequencies are given in brackets [ ]. Standard errors are given in parentheses ( ).

Other differences for mothers of other nonparticipant families compared to prenatal WIC participants and income-eligible nonparticipants include:

- only in the case of other nonparticipant women who have 8 years or less of education is the percentage of non-breastfeeders higher than breastfeeders (for the other two groups the statement is true for all those who have a high school education or less);
- only in the case of Black women is the percentage of non-breastfeeders higher than breastfeeders;
- a higher percentage of women who had prenatal care are breastfeeders than non-breastfeeders; and
- a higher percentage of women who had used alcohol, cigarettes, cocaine/crack, and marijuana in the prenatal period are breastfeeders than non-breastfeeders.

Finally, the percentage of other nonparticipants that use all types of daycare is higher for those families in which the mother is a breastfeeder.

Summary Profile

Table 3.5 is a summary table of weighted descriptive statistics (means and standard deviations) for all income-eligible women included in the NMIHS study, including prenatal WIC participants and income-eligible nonparticipants. These statistics are given for breastfeeder and non-breastfeeder categories.[3]

The statistics indicate that of all income-eligible breastfeeding women, 20.45 percent participate in the WIC Program during the prenatal period, and 25.29 percent participate during the postpartum period. Similarly, of all income-eligible non-breastfeeding women, 39.39 percent participate in the WIC Program during the prenatal period, and 49.45 percent participate during the postpartum period.

About 78 percent of prenatal WIC participant breastfeeders report that they receive breastfeeding advice from the WIC Program; only about

[3]Note that percentages given in Table 3.5 refer to the percent of breastfeeders and non-breastfeeders. For example, the sixth row in Table 3.5 indicates that 86.15 percent of breastfeeders are white, and 70.94 percent of non-breastfeeders are white.

Table 3.5. Comparison of Breastfeeders and Non-Breastfeeders: Income-Eligible Population

	Breastfeeders	Non-Breastfeeders
WIC Participants:		
Percent Prenatal [3868]	20.45 (0.81)	39.39 (0.94)
Percent Postpartum [4614]	25.29 (0.87)	49.45 (0.98)
Prenatal WIC Participants,		
Percent with WIC Breastfeeding Advice [2253]	77.82 (1.82)	55.75 (1.49)
Mother's Education:		
Mean Years [9953]	13.38 (0.05)	11.95 (0.05)
Mother's Age:		
Mean Years [9953]	27.51 (0.11)	24.90 (0.11)
Mother's Race:		
Percent White [4677]	86.15 (0.53)	70.94 (0.57)
Mother's Ethnicity:		
Percent Hispanic [890]	12.42 (0.66)	12.93 (0.70)
Mother's Marital Status at Time of Delivery:		
Percent Married [5868]	84.00 (0.75)	64.58 (0.89)
Prenatal Care:		
Pct w/ Prenatal Care [9616]	99.10 (0.20)	98.07 (0.23)
Mean No. Visits [9953]	11.75 (0.08)	10.77 (0.08)
Mother's Work Status After Delivery:		
Percent Worked [5503]	58.64 (1.00)	55.41 (0.98)
Father's Age:		
Mean Years [9953]	31.48 (0.12)	28.87 (0.12)
Father's Education:		
Mean Years [9953]	13.58 (0.06)	12.11 (0.05)
Mean Monthly Household Income [9953]	2644.57 (31.73)	1817.88 (28.17)
Infant Feeding Intention During Pregnancy*		
Percent Bottle [5066]	3.08 (0.33)	91.40 (0.57)
Percent Breast [2559]	67.83 (0.94)	4.53 (0.43)
Percent Both Bottle and Breast [1288]	28.59 (0.92)	2.80 (0.33)

Table 3.5. Comparison of Breastfeeders and Non-Breastfeeders: Income-Eligible Population

(continued)

	Breastfeeders	Non-Breastfeeders
Infant Sex:		
Percent Male [5039]	51.66 (1.01)	52.52 (1.00)
Infant Birthweight:		
Mean Grams [9946]	3443.31 (9.48)	3280.15 (9.56)
Mean Apgar Score at Five Minutes [8063]	9.04 (0.02)	8.98 (0.01)
Gestational Age:		
Mean No. Weeks [9452]	39.55 (0.04)	39.17 (0.05)

Data Source: 1988 National Maternal and Infant Health Survey.

* There is a significant number of observations with missing values in this category.

Note: Means, percent distributions, and standard errors are based on weighted data and are calculated using SUDAAN. Sample frequencies are given in brackets [ ]. Standard errors are given in parentheses ( ).

56 percent of prenatal WIC participant non-breastfeeders report they receive breastfeeding advice.

The statistics also indicate that, on average, income-eligible breastfeeders have 1.43 more years of education, are 2.61 years older, and have one more prenatal care visit than income-eligible non-breastfeeders. Similarly, fathers married to income-eligible breastfeeders have 1.47 more years of education, and are 2.61 years older than those married to income-eligible non-breastfeeders.

For income-eligible breastfeeders, about 86 percent are White, 14 percent are Black, 12 percent are Hispanic, 99 percent receive prenatal care, nearly 59 percent work after delivery, and nearly 68 percent indicate that they intended to breastfeed their infant.

For income-eligible non-breastfeeders, about 71 percent are White, 29 percent are Black, 13 percent are Hispanic, 99 percent received prenatal care, 55 percent worked after delivery, and over 91 percent indicate that they intended to bottle-feed their infant.

There does not appear to be a significant difference in breastfeeding by sex of the infant. Of all infants who were breastfed, 51.66 percent were male, and of all those not breastfed, 52.52 percent were male. Infants who are breastfed have higher average birthweight, Apgar scores, and gestational age, on average, than infants who were not breastfed.

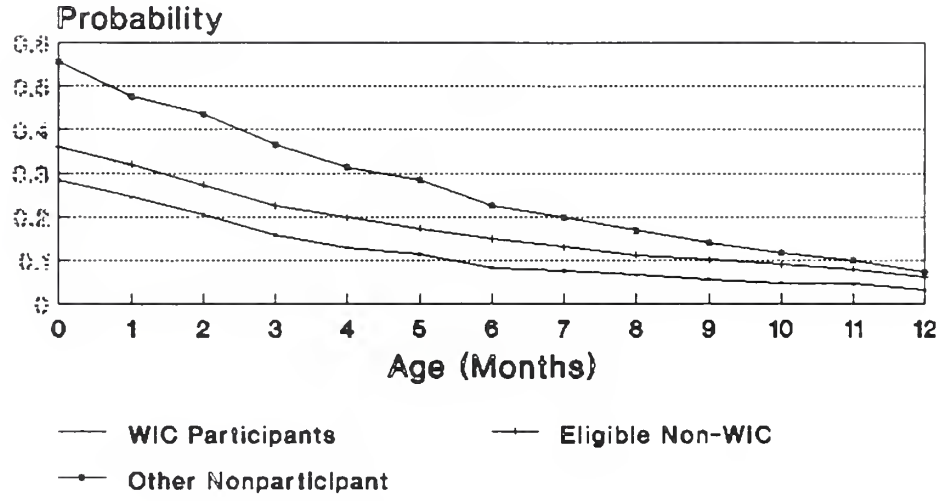
Breastfeeding Duration: Life-Table Analyses

The mean duration of breastfeeding for prenatal WIC participants, income-eligible nonparticipants, and other nonparticipants are 1.19, 1.63 and 3.32 months, respectively.

NMIHS data, corrected for design effects, is used to calculate weighted multiple-decrement life-table probabilities of breastfeeding for the first twelve months of life for prenatal WIC participants, income-eligible nonparticipants, and other nonparticipants. The life-table analyses of the probabilities of breastfeeding at specific monthly ages indicate that, throughout the first year, other nonparticipants are significantly more likely to breastfeed their babies than either prenatal WIC participants or income-eligible nonparticipants, and among the latter two groups, income-eligible nonparticipants are more likely to breastfeed than prenatal WIC participants.

Figure 3.1 graphically illustrates the results of the weighted multiple-decrement life-table analyses, and shows the trend of the monthly probability of any breastfeeding over the child's first year of life, by WIC eligibility and participation. The life-table probability of breastfeeding for prenatal WIC participants initially is .28, compared to .36 for income-eligible nonparticipants, and .56 for other nonparticipants.[4]

Figure 3.1 Life-Table Probability of Breastfeeding by WIC Participation and Income Eligibility



Weighted Multiple-Decrement Life Tables
Source: 1988 NMIHS

By the sixth month, the life-table probability of breastfeeding for prenatal WIC participants decreases to .08, compared to .15 for income-eligible nonparticipants, and .23 for other nonparticipants.

[4]The weighted multiple-decrement life-table probabilities also correct for censoring, and thus are slightly different than the simple breastfeeding percentages. Only 3.2 percent of the NMIHS sample women were right censored, i.e., were breastfeeding at the time of the survey.

The life-table probability of breastfeeding for all three groups significantly decreases by the twelfth month after birth. The life-table probability of breastfeeding for prenatal WIC participants in the twelfth month is reduced to .03, compared to .06 for income-eligible nonparticipants, and .07 for other nonparticipants.

Conclusion

This chapter has presented various descriptive statistics that serve to profile the characteristics of prenatal WIC participants, income-eligible nonparticipants, and other (high income) nonparticipants. In particular, differences between the three groups in terms of breastfeeding practice are noted.

It is important to emphasize, however, that there are many possible reasons for observed differences in breastfeeding practice between prenatal WIC participants, income-eligible nonparticipants, and other nonparticipants. As noted in this section, the background socio-economic characteristics of these three groups appear to differ along with prenatal WIC participation.

It is only when all differences between individuals are fully controlled in a multivariate estimation, that an analysis can correctly assess whether prenatal WIC participation is associated with breastfeeding behavior. The following section describes the multivariate model that controls for these differences, and presents the results of the multivariate estimation.

4. MULTIVARIATE MODEL AND RESULTS

MULTIVARIATE MODEL

The primary questions addressed by the multivariate analysis are the effects of prenatal WIC participation on whether the woman initiates breastfeeding and the duration of breastfeeding. The statistical methods that are used in this analysis take into account the fact that prenatal WIC participation, breastfeeding initiation, and duration of breastfeeding are choices a woman makes, and that these choices can be influenced by the same set of factors.

The multivariate model used in this analysis corrects for the so-called "selectivity bias" problem that arises when comparisons are made between individuals who receive WIC benefits and individuals who do not. The selection bias problem in such comparisons arises because prenatal WIC participants and nonparticipants may differ in breastfeeding behavior even in the absence of the WIC Program. For example, it may be that women who are less likely to breastfeed in the first place are more likely to participate in the WIC Program, leading to a spurious downward bias in the estimated effect of WIC participation if that estimate is based on simple comparison of WIC participants to nonparticipants.[5]

The multivariate model specifies an interrelated chain of observable behaviors or outcomes for the income-eligible population, both prenatal WIC participants and nonparticipants. In the model, these outcomes are represented by equations. The first outcome, for those women who are income-eligible, is whether the woman is a prenatal WIC participant. The second outcome is whether the woman initiates breastfeeding when her child is born. Finally, the third outcome is, for those women who initiate breastfeeding, the duration of breastfeeding. Each of these outcomes is modelled separately as a multivariate equation, and then linked in a system of equations that are estimated simultaneously.

The model uses a "maximum-likelihood" technique that estimates the three decisions (equations) jointly and simultaneously. Operationally, this involves simultaneously finding the coefficients of the three equations so as to maximize the "fit" of the three equations together to the data. The technique corrects for selectivity bias by estimating the correlation in unmeasured factors that affect both prenatal WIC participation and breastfeeding initiation and duration. A detailed

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[5]This bias would be present in the coefficient on a WIC participation dummy variable in a simple Ordinary Least Squares (OLS) equation, for example.

statistical description of the multivariate model used in this analysis is presented in Appendix A.

Several alternative statistical model specifications were tested. The details of these alternative specifications are presented in Appendix B.

Simulation Method

The estimation of the three equations described above generates a large number of estimated coefficients. To aid in the interpretation of the results, a simulation method is used that allows a quantification of the effects of changes in the independent variables (e.g., education) on dependent variables (prenatal WIC participation, breastfeeding, and duration of breastfeeding). The simulation results are generated by solving the system of equations with the estimated coefficients, and then testing the effects of changes in independent variables on dependent variables.

For example, using the simulation method combined with the coefficient results from the multivariate model, the magnitude of the effect of prenatal WIC participation on the likelihood of breastfeeding is determined.

MULTIVARIATE RESULTS

Descriptive statistics for the breastfeeding and non-breastfeeding groups groups were presented in Chapter 3. Results of the descriptive analysis suggest that prenatal WIC participation is negatively correlated with breastfeeding. Such a suggested correlation is overly simplistic because multiple effects of other factors are not taken into account. Unfortunately, important policy conclusions often are drawn from just such simple correlations.

The important policy question, and one that can best be answered with multivariate analysis, is whether participating in the WIC Program leads to reductions in breastfeeding, or whether the lower levels of breastfeeding observed for prenatal WIC participants can be explained by factors other than Program participation that differ between prenatal WIC participants and nonparticipants, such as income, age, and education.

Using the multivariate statistical model explained in detail in Appendix A, the relationship between prenatal WIC participation and breastfeeding behavior is estimated while controlling for other variables which are expected to affect the decision to breastfeed.

Coefficients are estimated for each independent variable. These coefficients indicate the direction and magnitude of the effect of each independent variable (e.g., age, education, race) on each of the three dependent variables (prenatal WIC participation, breastfeeding, and duration of breastfeeding). For example, if the estimated coefficient for education in the breastfeeding estimation is positive, then the interpretation of the coefficient is that higher levels of education are independently correlated with a higher likelihood of breastfeeding, while controlling for all other independent variables in the estimation.

Prenatal WIC Participation

Table 4.1 presents the multivariate estimation results for whether income-eligible women participate in the WIC Program during the prenatal period.

The results are statistically strong and much as expected. The results suggest that younger mothers, Blacks, Hispanics, mothers who live with the infant's father, mothers with lower levels of formal education, mothers in the lower income quintiles of this (low) income-eligible sample, mothers living outside metropolitan areas, and mothers living in households with fewer members, have increased likelihoods of participating in the WIC Program during the prenatal period.

Breastfeeding Initiation

Table 4.2 presents the multivariate estimation results for the likelihood that the mother breastfeeds the index infant. The estimation controls for prenatal WIC participation, WIC breastfeeding advice, and other factors.

The estimation results indicate the importance of the multivariate method. When the other variables are controlled, the relationship between WIC participation and breastfeeding initiation becomes much clearer than in the simple correlational results presented in Chapter 3.

The effect of prenatal participation in the WIC Program can only be understood as a net result of two aspects of prenatal WIC participation, the first being prenatal WIC participation and the second being that as part of participation, the mother receives breastfeeding advice.

The results of the estimation suggest that if a mother participates in the WIC Program and receives no breastfeeding advice as a part of the program, she will be less likely to breastfeed her infant than will a similar mother who does not participate in WIC. This relationship is

Table 4.1 Prenatal WIC Participation: Multivariate Results

	Coefficient	Standard Error	t-statistic
Mother's Age	-.0378***	.0077	-4.9087
Father's Age	.0093	.0078	1.1983
Mother's Education	-.0532**	.0171	-3.1183
Father's Education	-.0225	.0217	-1.0354
Mother Black	.5608***	.0890	6.2993
Mother Hispanic	.3733*	.1522	2.4524
Income Quintile 1	-.1965	.1074	-1.8300
Income Quintile 2	-.2283*	.1027	-2.2240
Income Quintile 3	-.3828***	.1129	-3.3904
Income Quintile 4	-.5890***	.1017	-5.7901
WIC Food Expend/Capita	.7593	.4285	1.7719
Metropolitan Area	-.5073***	.1021	-4.9686
Household Size	-.0433***	.0114	-3.7937
Mother Lives With Child's Father	.8066**	.4043	1.9953
Lives w/ Child's Father x Father's Education	-.0372	.0262	-1.4203
Lives w/ Child's Father x Father's Age	-.0178	.0096	-1.8554
Constant	2.3061***	.4345	5.3079

Data Source: 1988 National Maternal and Infant Health Survey.

***statistically significant at the .001 level.
**statistically significant at the .01 level.
*statistically significant at the .05 level.

Table 4.2 Breastfeeding Initiation: Multivariate Results

	Coefficient	Standard Error	t-statistic
Prenatal WIC Participation	-.4783***	.1151	-4.1552
WIC Breastfeeding Advice	.9346***	.0983	9.5040
Mother's Age	.0168	.0086	1.9492
Father's Age	.0071	.0087	.8123
Mother's Education	.1139***	.0197	5.7721
Father's Education	.0811**	.0270	3.0047
Mother Black	-1.8371***	.1601	-11.4758
Mother Hispanic	.6571***	.1471	4.4688
Income Quintile 1	-.5076***	.0939	-5.4059
Income Quintile 2	-.1889*	.0888	-2.1267
Income Quintile 3	-.2512**	.0973	-2.5808
Income Quintile 4	-.0624	.0919	-.6786
Household Size	.0084	.0143	.5893
Metropolitan Area	-.0499	.1108	-.4499
Metropolitan Area x Mother Black	1.0438***	.1994	5.2337
Mother Lives With Child's Father	-.0859	.4875	-.1761
Lives With Child's Father x Father's Education	.0106	.0356	.2967
Lives With Child's Father x Father's Age	.0167	.0117	1.4256
Constant	-3.1159***	.4704	-6.6239

Data Source: 1988 National Maternal and Infant Health Survey.
***statistically significant at the .001 level.
**statistically significant at the .01 level.
*statistically significant at the .05 level.

indicated by the negative and statistically significant coefficient on the prenatal WIC participation variable.

On the other hand, if the prenatal WIC participant receives advice to breastfeed as part of the WIC Program she will be more likely to breastfeed her infant. The association of both being in the WIC Program and receiving breastfeeding advice, therefore, is that the mother will be more likely to breastfeed her infant. Thus, once other causal factors are controlled, prenatal WIC participants will only be less likely to breastfeed than similar income-eligible nonparticipants when no breastfeeding advice is received as part of the WIC Program.

Because the NMIHS survey was conducted in 1988, well before the USDA published the 1990 regulations to further promote breastfeeding, it is not surprising that a portion of the prenatal WIC participants in the NMIHS sample reported that they did not receive breastfeeding advice from the WIC Program.

Eight of the other sixteen control variables in the breastfeeding estimation are statistically significant, suggesting that the model works well to control for other factors affecting the breastfeeding decision. The results are of interest and suggest that Black women, women who meet the WIC income-eligibility requirements, and who live in metropolitan areas are less likely ever to breastfeed, while more educated mothers, Hispanic mothers, and Black mothers living in a metropolitan area are more likely to breastfeed. In addition, the baby's father's education is positively associated with breastfeeding.

Alternative Breastfeeding Estimation

Whether breastfeeding advice was received by the prenatal WIC participant was a self-reported item in the NMIHS survey. Thus, the multivariate results may be biased to the extent that prenatal WIC participants who actually breastfed were more likely to recall breastfeeding advice received from the WIC Program. Also, it is possible that breastfeeding advice is provided selectively to those who express an interest in breastfeeding and who are, therefore, more likely to breastfeed anyway. Given the statistical strength of the effect of breastfeeding advice, however, it is not likely that this possible confounding effect seriously compromises the results.

To examine this issue, an alternative estimation was performed that includes the prenatal WIC participation variable, but excludes the WIC breastfeeding advice variable. The coefficient on WIC participation in the alternative estimation was positive and approached statistical signifi-

cance. The t-statistic was 1.63, which is associated with a p-value of .10. This alternative estimation result indicates that, with the other factors in the model controlled, WIC participation does not have a statistically significant association with either increased or decreased initiation of breastfeeding. In other words, after controlling for socioeconomic differences between them, WIC participants and eligible nonparticipants have an almost equal probability of initiating breastfeeding.

The complete set of estimated coefficients for the alternative breastfeeding estimation is presented in Appendix C.

Breastfeeding Duration

Table 4.3 presents the multivariate estimation results for the duration of breastfeeding, controlling for WIC participation and other factors. For those who initiate breastfeeding an important question is how long they will continue. The results suggest that once other causal factors are controlled, for those women who breastfeed, neither prenatal WIC participation nor WIC breastfeeding advice appear to significantly affect how long the mother will breastfeed her child.

The results appear to indicate that the importance of factors such as prenatal WIC participation and breastfeeding advice relate to the decision to breastfeed, not to the decision about how long to continue. However, it is not clear what the exact nature of the breastfeeding advice at WIC clinics is during the prenatal period, given the flexibility permitted in the Program, and the variability in breastfeeding promotion practices among States. Breastfeeding promotion undertaken prenatally may increase the initiation of breastfeeding, but perhaps different WIC breastfeeding promotion strategies are needed to increase breastfeeding duration.

As in the breastfeeding equation, a large number of the control variables seem to be statistically significant factors in the duration of breastfeeding decision. Mothers who are older, and who both are Black and live in metropolitan areas tend to breastfeed longer. Mothers who are younger, Black, who are both Black and live in non-metropolitan areas, and who live with the infant's father tend to breastfeed for a shorter duration.

Finally, it is interesting to note that few of the factors that affect the decision to breast seem to affect the duration of breastfeeding. This is in a sense consistent with the interpretation suggested above for the WIC relationships - once the breastfeeding initiation decision is made,

Table 4.3 Breastfeeding Duration: Multivariate Results

	Coefficient	Standard Error	t-stat
Prenatal WIC Participation	.0334	.2407	.1389
WIC Breastfeeding Advice	-.0756	.1585	-.4769
Mother's Age	.0466***	.0095	4.9194
Father's Age	-.0327*	.0165	-1.9826
Mother's Education	.0230	.0229	1.0052
Father's Education	-.0415	.0416	-.9987
Mother Black	-.8382**	.3083	-2.7191
Mother Hispanic	-.1235	.1591	-.7761
Income Quintile 1	-.0226	.1725	-.1309
Income Quintile 2	-.2160	.1254	-1.7229
Income Quintile 3	.0045	.1316	.0342
Income Quintile 4	.0804	.1190	.6758
Household Size	.0257	.0232	1.1077
Metropolitan Area	-.1365	.1511	-.9032
Metropolitan Area x Mother Black	.6749*	.2857	2.3622
Mother Lives With Child's Father	-2.2001**	.7223	-3.0460
Lives With Child's Father x Father's Education	.0699	.0453	1.5423
Lives With Child's Father x Father's Age	.0470**	.0182	2.5860
Constant	-.1994	.2204	-.9049

Data Source: 1988 National Maternal and Infant Health Survey.

***statistically significant at the .001 level.
**statistically significant at the .01 level.
*statistically significant at the .05 level.

many of the factors that seem to affect it do not in turn appear to affect how long those who make the decision to breastfeed will continue.

SIMULATION RESULTS

Whether an independent variable has a large or small effect on breastfeeding is difficult to determine directly from the results of the multivariate model. To aid in the interpretation of the results, a simulation model is used to quantify the size of the effects of changes in the independent variables (e.g., prenatal WIC participation) on breastfeeding initiation and duration. A simulation exercise is conducted with a focus on the important determinants of breastfeeding.[6]

The simulation method was used to predict four distinct outcomes:

- the likelihood of initiation of breastfeeding;
- the duration of breastfeeding, in months;
- the likelihood of breastfeeding at age three months; and
- the likelihood of breastfeeding at age six months.

Table 4.4 presents the simulation exercise results, weighted to correct for sample design effects. The simulations simplify the interpretation of the results from the statistical modelling.

WIC Effect

The first set of simulations is concerned with the association of prenatal WIC participation and the initiation of breastfeeding. The average prenatal WIC participant, who does not receive WIC breastfeeding advice, is found to be considerably less likely to breastfeed. The second and third rows of the first column of Table 4.4 indicate that 25.8 percent of prenatal WIC participants, and 34.7 percent of income-eligible nonparticipants, are breastfeeders. Thus, the model predicts that an additional 8.9 percent of income-eligible nonparticipant mothers would be breastfeeders, relative to the number that would be breastfeeders if they were prenatal WIC participants, but did not receive WIC breastfeeding advice (Figure 4.1).

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[6]Details of the simulation method are given in Appendix A.

Table 4.4. Simulation Results: Determinants of Breastfeeding for the WIC Income-Eligible Population

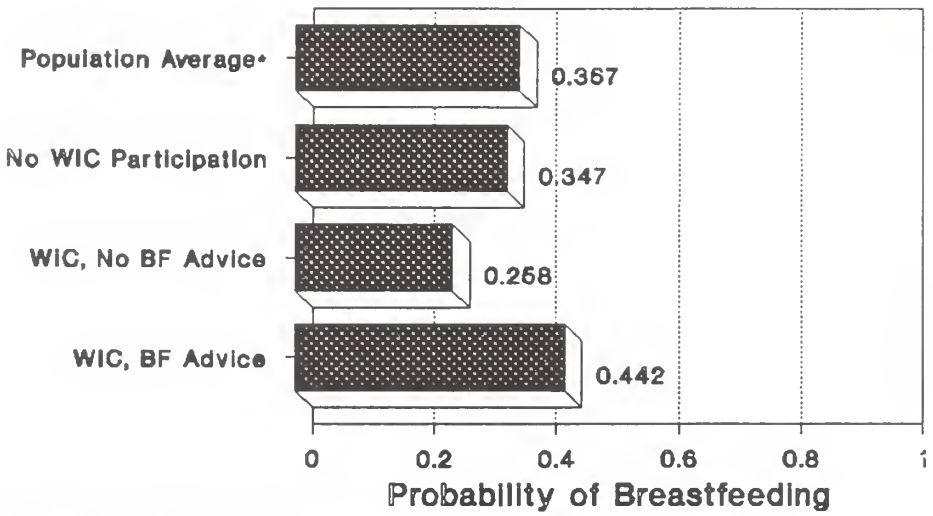
	Likelihood of Initiating Breastfeeding	Duration* (months)	Duration Probability** at 3 months	Duration Probability** at 6 months
Income-Eligible Population Average	.367	3.78	.583	.235
WIC Participation, no Breastfeeding Advice:	.258	3.83	.573	.236
No WIC Participation	.347	3.79	.581	.235
WIC Participation, with Breastfeeding Advice:	.442	3.74	.590	.234
Hispanic:				
Yes	.436	3.66	.606	.231
No	.342	3.80	.577	.236
Location/Race:				
NonMetro NonBlack	.422	3.99	.540	.241
Metro NonBlack	.411	3.83	.573	.238
NonMetro Black	.119	2.99	.744	.186
Metro Black	.254	3.63	.611	.231
Education:				
4 years	.213	3.58	.623	.228
8 years	.289	3.68	.602	.232
12 years	.377	3.79	.580	.236
Age:				
18 years old	.347	3.45	.648	.224
23 years old	.363	3.22	.595	.236
28 years old	.380	4.00	.539	.244

Data Source: 1988 National Maternal and Infant Health Survey.

*For those who initiated breastfeeding.

**Probability for those who initiated breastfeeding.

Figure 4.1 Effect of Prenatal WIC Participation on Breastfeeding Initiation Among WIC Eligibles



*Income-Eligible Population
Source: 1988 NMIHS

The important point is that for prenatal WIC participants who report having received breastfeeding advice, the probability of breastfeeding almost doubles to .442, an increase over prenatal WIC participants without breastfeeding advice of 18.4 percentage points, as is indicated by the fourth row of simulation results. Thus, even though descriptive analyses suggest that prenatal WIC participation reduces breastfeeding, multivariate analyses suggest that the receipt of breastfeeding advice through WIC increases the probability of breastfeeding. The difference between WIC participants who report such advice and similar mothers who do not participate in WIC at all is 9.5 percentage points.

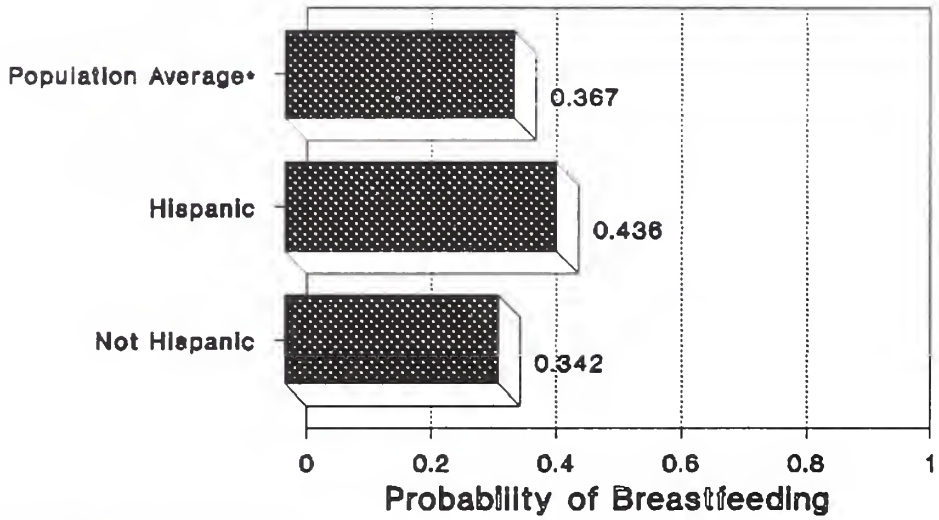
Demographic Effects

Another policy question examined by the simulation model relates to targeting, and suggests certain socio-demographic groups who require special attention. Four important factors, ethnicity, race and location, education levels, and age are considered.

The simulation results indicate that:

- Hispanics are 9.4 percentage points more likely to breastfeed than non-Hispanics (Figure 4.2);

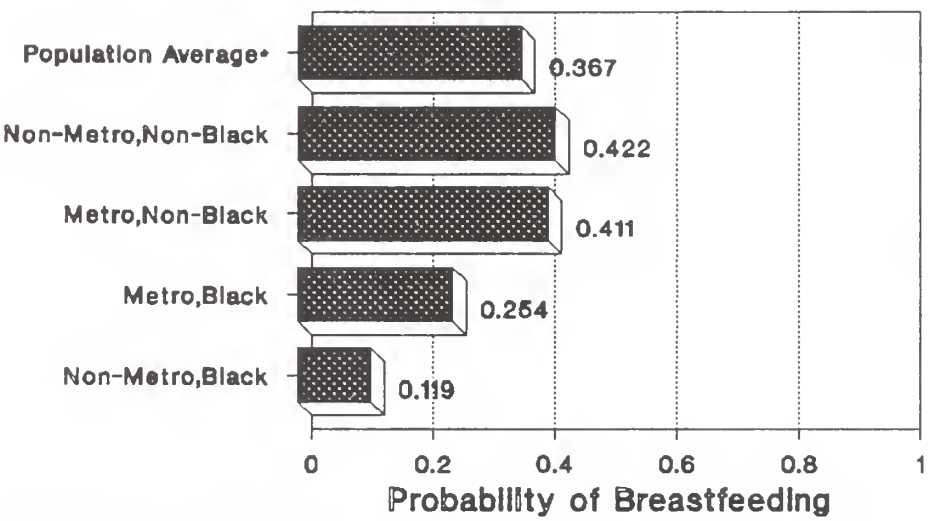
Figure 4.2 Effect of Ethnicity on Breastfeeding Initiation Among WIC Eligibles



*Income-Eligible Population
Source: 1988 NMIHS

- among Black mothers, those residing in metropolitan areas are more than twice as likely to breastfeed than those in non-metropolitan areas, and both metro and non-metro rates are lower than those for non-Blacks (Figure 4.3);

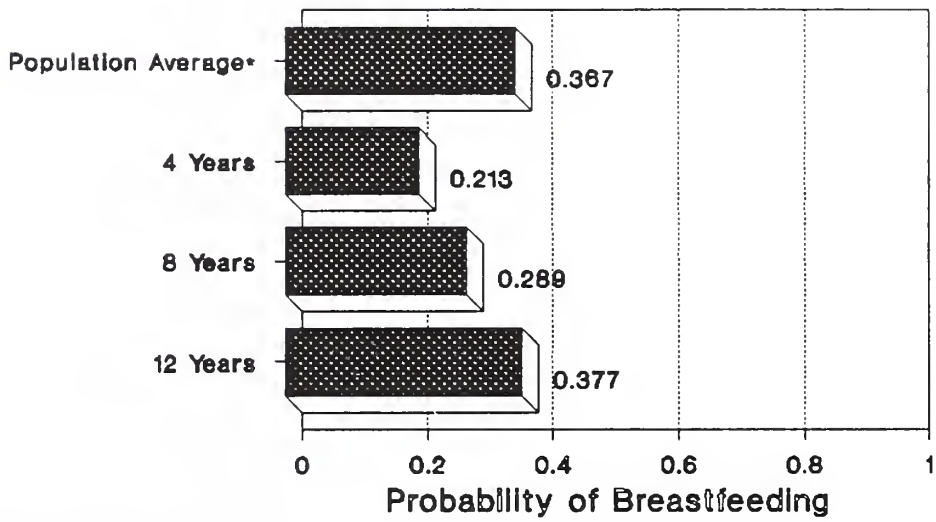
Figure 4.3 Effect of Location and Race on Breastfeeding Initiation Among WIC Eligibles



*Income-Eligible Population
Source: 1988 NMIHS

- women who have 12 years of education are .088 more likely to breastfeed than women with only 8 years of education (Figure 4.4); and

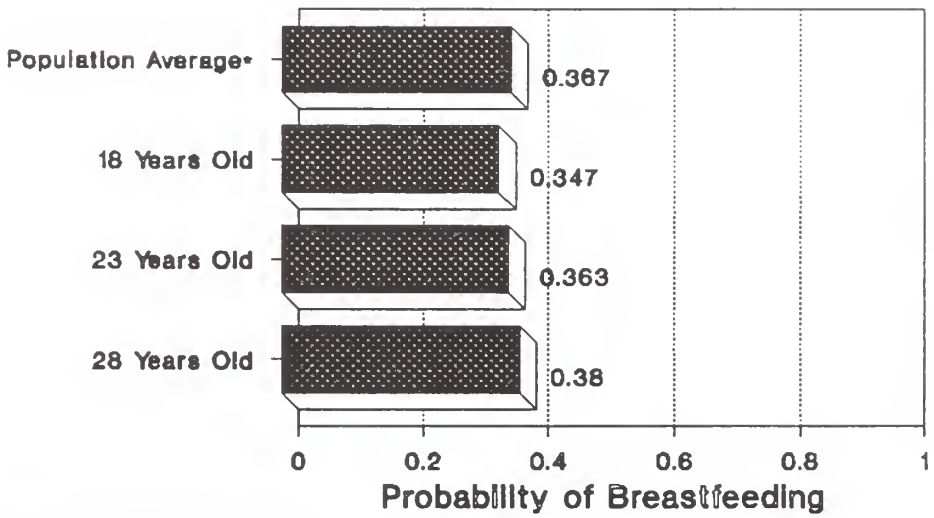
Figure 4.4 Effect of Education on Breastfeeding Initiation Among WIC Eligibles



*Income-Eligible Population
Source: 1988 NMIHS

- older women are slightly more likely to initiate breastfeeding than younger women (Figure 4.5).

Figure 4.5 Effect of Age on Breastfeeding Initiation Among WIC Eligibles



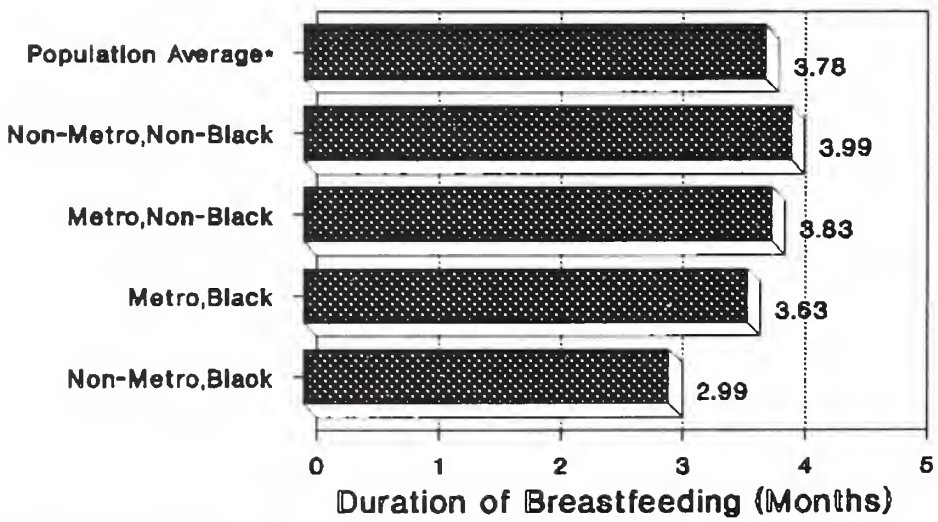
*Income-Eligible Population
Source: 1988 NMIHS

Duration

The results shown in columns 2, 3, and 4 of Table 4.4 suggest that prenatal WIC participation has no meaningful association with the duration of breastfeeding. The results suggest that all income-eligible women, be they prenatal WIC participants with or without prenatal WIC breastfeeding advice, or nonparticipants, if they do initiate breastfeeding, tend to breastfeed for the same length of time.

The simulation model reveals that for mothers who initiate breastfeeding, most of the socio-demographic factors do not have a major effect on the duration of breastfeeding. The exception is in the difference between metropolitan (urban) and non-metropolitan (rural) Blacks. Urban Blacks who breastfeed have a much longer duration of breastfeeding than rural Blacks. Urban Black infants are predicted to breastfeed for 0.64 months longer than rural Black infants (Figure 4.6).

Figure 4.6 Effect of Location and Race on Breastfeeding Duration Among WIC Eligibles



*Income-Eligible Population
Source: 1988 NMIHS

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APPENDIX A

MULTIVARIATE MODEL AND ESTIMATION METHODS

MULTIVARIATE MODEL

The key questions for the multivariate analysis are the effects of the WIC Program both on breastfeeding initiation and breastfeeding duration. The statistical methods that are employed must take into account the fact that participation in the WIC Program is also a choice the mother makes and that this choice can be influenced by the same set of factors, both observable and unobservable, that influence decisions about breastfeeding. Therefore, the model must specify a chain of decisions that the mother makes. The first decision, for those who are eligible, is whether to enroll in the WIC Program. The mother must also decide whether or not to initiate breastfeeding after the child is born. Finally, if she initiates breastfeeding, she must decide when to stop.

The WIC participation decision and the initiation of breastfeeding decision are binary dependent variables, while duration of breastfeeding has a continuous range for those that breastfeed. The statistical literature has analyzed duration of time decisions within the framework of either discrete time or continuous time hazard models (see Lancaster, 1990). Discrete time models are used for this analysis for several reasons. First, duration of breastfeeding recall data tends to be heaped at certain points in time such as three months, six months or a year. Second, discrete time hazard models are quite flexible and relatively easy to apply (see Allison, 1982 and Guilkey and Rindfuss, 1987). Finally, the use of discrete time for the duration decision makes the form of this dependent variable consistent with the other dependent variables in the system.

Binary dependent variables have either been analyzed using probit or logit. Probit has the advantage of being based on the assumption of normality for the error term, a frequently used error assumption for continuous dependent variables. The multivariate normal distribution is also a straightforward method for allowing unobservable variables to be correlated across equations. Logit is used in this analysis since it is the method that is typically used to analyze discrete time hazard models, and logit and probit give very similar results for binary choice models. Even though logit is used in this analysis, the method controls for common unobservable variables that affect both WIC participation decisions and breastfeeding decisions.

Prenatal WIC Participation

The first choice analyzed is the prenatal WIC participation decision, given WIC eligibility (Equation 1):

$$\log \frac{P(W_i=1)}{P(W_i=0)} = X_i\beta + \rho_W\mu_i \quad i=1,2,\ldots,N.$$

where W_i is a variable that indicates whether individual i is a WIC participant (1 = yes, 0 = no). The X_i's are a set of observable characteristics of the individual, such as education and income, and characteristics of the WIC Program in the State in which the individual resides. The μ_i's represent unobservable variables associated with individual i that affect both the individual's decision to participate in WIC and the breastfeeding initiation and duration decisions, the individual's level of motivation to provide a healthy environment for her child, for example. An independent, random error is implicit in the logit specification. Finally, β and ρ_W are unobserved regression parameters to be estimated.

Breastfeeding Initiation

The second choice that is analyzed is the breastfeeding initiation decision modeled as follows (Equation 2):

$$\log \frac{P(BF_{0i}=1)}{P(BF_{0i}=0)} = Z_i\alpha_0 + W_i\tau_0 + Z_iW_i\delta_0 + \rho_0\mu_i$$

where BF_{0i} is a dichotomous variable that indicates whether or not respondent i initiated breastfeeding (1 = yes, 0 = no).

The Z_i are a set of variables that are hypothesized to affect the initiation decision. The WIC Program is hypothesized to have both additive and multiplicative effects on the breastfeeding decision. The interaction terms are included partly because of the breastfeeding advice aspects of the WIC Program. These programs may have differing effects the behaviors of individuals of different levels of education, for example. The α, τ, ρ, and δ represent unobserved regression coefficients to be estimated and μ_i is as defined above.

Breastfeeding Duration

The final set of equations in the system concern the duration of breastfeeding decision (Equation 3):

$$\log \frac{P(BF_{ji}=1 \mid BF_{j-1,i}=1)}{P(BF_{ji}=0 \mid BF_{j-1,i}=1)} =$$

$$Z_i\alpha_j + W_i\tau_j + Z_iW_i\delta_j + \rho_j\mu_i$$

where j = 1,2,...,J. The dependent variable is the log odds of the probability that respondent i breastfed (1 = yes, 0 = no) through interval j conditional upon having breastfed in interval j-1 and all other variables are as previously defined.

The discrete time hazard model has several attractive features. It is straightforward to allow for right censoring (women who are still breastfeeding at the time of the survey) since women can be included in the sample up to the point of censoring. (Only 3.2 percent of the NMIHS women were still breastfeeding at the time of the survey). The coefficients can be allowed to vary interval to interval so the hazard is not constrained to be proportional. Finally, as the size of the interval gets small, the model reduces to the continuous time Cox proportional hazard model.

ESTIMATION METHOD

The estimation strategy is to estimate Equations 1 through 3 simultaneously by maximum likelihood methods. The reason for the joint estimation is that this approach effectively controls for the endogeneity of the WIC Program in the breastfeeding and duration of breastfeeding equations. It also controls for the sample selectivity in the breastfeeding duration decision.

The likelihood function can be specified by first examining the contribution to the likelihood function by individual i. Suppose individual i is a WIC participant who never breastfed. Then

$$L_i(. \mid \mu) = P(W_i=1 \mid \mu)P(BF_{0i}=0 \mid \mu).$$

Suppose the individual is not a WIC participant, breastfed one period, and terminated in the second:

$$L_i(.|\mu) =$$

$$P(W_i=0|\mu)P(BF_{0i}=1|\mu)P(BF_{1i}=1|\mu)P(BF_{2i}=0|\mu).$$

The rules of probability are used to generate the joint probability of any sequence of outcomes for any individual conditional upon μ. The unconditional joint probability is obtained by integrating out with respect to μ. A variety of methods have been proposed to do this. Heckman and Singer (1984) developed a non-parametric method that makes no distributional assumptions about μ for continuous time hazard models. Mroz and Weir (1990) adapted this strategy for a discrete time hazard model.

The approach taken in this analysis is to assume that the μ_i come from a normal distribution with mean 0 and variance 1. Fifty draws are made from this distribution for each individual and a simple average is taken from the resulting fifty values of L_i to obtain unconditional joint probabilities.

Guilkey and Murphy (1991) found that this method works almost as well as Hermite integration as long as sufficient numbers of draws were used. The number of draws were simply kept increasing until the results stabilized. This method is flexible since it is easy to see how robust the results are to changes in the parametric assumptions made about μ. For example, if it is assumed that μ follows a uniform distribution, one simply makes random draws from the uniform distribution as opposed to the normal. Although the results presented below assume a normal distribution, the uniform distribution was also tried and resulted in similar results.

Identification

The final point that needs to be made about the maximum likelihood estimation procedure concerns identification of this structural equations model. Note that separate vectors of regressors for the WIC participation equation and the breastfeeding equations are specified. In fact, the empirical specification contains a great deal of overlap. Technically, the system of equations is statistically identified even with complete overlap of the independent variables due to nonlinearities. However, as will be seen below, identification through nonlinearities does not need to be relied upon because valid exclusion restrictions in the breastfeeding equations are present.

Design Effects Correction

The NMIHS survey is based on a stratified probability sample. It is well known that, with this type of sampling, the estimated point estimates of the coefficients in the multivariate analysis are statistically correct but the standard errors are biased downwards. This means that the use of the uncorrected standard errors leads to an overstatement of the significance of the results. Therefore, standard errors are corrected by using a Taylor's series approximation to the true covariance matrix of the parameter estimates. See Guilkey (1992) for details on the use of these methods and their effects on standard errors in similar models. The correction is essentially an extension of the SUDAAN methodology to this particular statistical model.

SIMULATION METHOD

The estimation of the three equations described above generates large numbers of estimated coefficients. To aid in the interpretation of the results, a simulation program was developed that allows a quantification of the effects of changes in the independent variables on participation in the WIC Program and the initiation and duration of breastfeeding. The simulation results are generated by solving Equations 1 and 2 for the probability of WIC participation and the probability of breastfeeding respectively.

Equation 3 along with the probability of breastfeeding is used to determine the probability that the individual will breastfeed any chosen length of time. These probabilities are then be used generate expected duration by using the midpoints of the chosen time intervals (for details, see Guilkey and Rindfuss, 1987).

The procedure followed in the simulation exercise was to use all individuals, predict their probabilities and durations, and then average these values over fifty draws for μ. The final results were obtained by averaging over individuals. The entire procedure can then be repeated by increasing everyone's income, for example, and determining how the probabilities and duration are affected by this change.

The simulations were performed by first using the actual values of all variables for each observation (infant-mother pair) and then calculating what happens to the four breastfeeding outcomes when these values are changed in specific ways. For example, the likelihoods are calculated for each member of the full sample of mothers, with each observed mother assigned her characteristics on every variable except prenatal WIC participation, and then simulating the four outcomes with and without prenatal WIC participation (WIC variable changed from non-participation to participation for each observation).

APPENDIX B

ALTERNATIVE MODEL SPECIFICATIONS

ALTERNATIVE MODEL SPECIFICATIONS

For specific reasons discussed in the following paragraphs, several alternative statistical model specifications were tested.

Mother's Age

Mother's age was categorized into 4 categories to test for non-linear age effects. This set of variables performed poorly, in the sense that the individual coefficients on the variables were not statistically significant, in both breastfeeding equations. The model was also estimated with a specification where the mother's age term was squared, in order to test for non-linear age effects in a different manner. The squared term also was not statistically significant. These results were accepted as evidence that the simple continuous mother's age term was the proper statistical specification.

Father's Age

A version of the model with father's age omitted from the breastfeeding equations was estimated in order to determine the effect on the mother's age effect. The result was as expected: mother's age became statistically significant at a higher level of confidence. However, because when both father's and mother's age are included, mother's age is statistically significant at a reasonable level and the theoretical reasons for including father's age are compelling, it was decided to keep the father's age variable in the final model.

Race

A specification with two dummy variables for race was initially tested: "Black" and "white," with the race "other" as the excluded choice. The "other" category, however, made up only two percent of the sample, and in the estimations the coefficient on the white dummy variable was not statistically significant. As a result it was concluded that the proper specification was to include only a Black race dummy variable, with the excluded class becoming all non-Black.

Race Interactions

Various interactions of the Black race dummy variable were tested. The only one found to be significant was a Black race with metropolitan residence interaction is retained in the final model.

Living Arrangements

A specification was tested which included three separate living arrangement categories: "live alone," "live with child's father," and "live with children." Because only the "live with child's father"

variable was statistically significant, the other two variables were dropped from the final equations.

Region

A specification including the region of the country dummy variables also was tried, but these variables proved to be highly collinear with our two identifying variables, and to cause them to lose statistical significance. For this reason the regional variables were dropped from the final model.

Other Interactions

Tests were also run of specifications which included interactions of the WIC participation variable with various exogenous variables, including mother's age and education in the breastfeeding equations. None of these interactions proved to be statistically significant.

State-Level Variables

Two State-level WIC Program expenditure variables, WIC Program administrative expenditures per capita and WIC Program food expenditures per capita, were initially tested. Because administrative expenditures per capita were found not to be statistically significant the variable was dropped from the final specification.

Birthweight

Some would argue that birthweight should be included as an independent variable in the model of breastfeeding initiation and duration, but we consider birthweight endogenous to the breastfeeding decision. That is, the determinants of birthweight are the same as those that lead to breastfeeding behavior. In order to test for the effect of excluding birthweight, birthweight was included in the model and the results found for prenatal WIC participation and breastfeeding advice, and the associated t-statistics, were essentially unchanged.

APPENDIX C

ALTERNATIVE BREASTFEEDING ESTIMATION

Table C.1 Alternative Breastfeeding Estimation: Multivariate Results

	Coefficient	Standard Error	t-statistic
WIC Participation	.1483	.0911	1.6276
Mother's Age	.0141	.0085	1.6614
Father's Age	.0093	.0088	1.0638
Mother's Education	.1216***	.0198	6.1405
Father's Education	.0822**	.0269	3.0562
Mother Black	-1.8490***	.1609	-11.4891
Mother Hispanic	.6904***	.1441	4.7913
Income Quintile 1	-.5089***	.0892	-5.7039
Income Quintile 2	-.1873*	.0860	-2.1774
Income Quintile 3	-.2371**	.0942	-2.5155
Income Quintile 4	-.0500	.0882	-.5664
Household Size	.0067	.0136	.4955
Metropolitan Area	-.0406	.1091	-.3725
Metropolitan Area x Mother Black	1.0434***	.1987	5.2510
Mother Lives With Child's Father	-.0069	.4860	-.0142
Lives With Child's Father x Father's Education	.0096	.0356	.2689
Lives With Child's Father x Father's Age	.0154	.0115	1.3378
Constant	-3.8702***	.4590	-8.4319

Data Source: 1988 National Maternal and Infant Health Survey.

***statistically significant at the .001 level.
**statistically significant at the .01 level.
*statistically significant at the .05 level.

☆U.S. Government Printing Office : 1992 - 341-375/60939